GREATER SAGE-GROUSE (*Centrocercus urophasianus*)

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Criteria Scores

Population Trend	Range Trend	Population Size	Range Size	Endemism	Population Concentration	Threats
10	15	7.5	10	0	5	10

Special Concern Priority

Currently greater sage-grouse are considered a Bird Species of Special Concern (year-round) on the CDFG 1992 list. Also, greater sage-grouse were considered a Bird Species of Special Concern (year-round) on the original list (Remsen 1978).

Breeding Bird Survey Statistics for California

The data was inadequate for developing a trend assessment (Sauer et al. 2000).

General Range and Abundance

Greater sage-grouse are resident natives to the Great Basin region of northeastern California (Grinnell and Miller 1944), including Modoc and Lassen counties and east of the Sierra Nevada including Mono and northern Inyo counties and portions of Sierra County. Due to their reliance on sagebrush for food during the fall and winter months, and for year-round cover, sage grouse are limited to a semi-arid sagebrush habitat.

Seasonal Status in California

Occurs year round; breeding season extends from March through April.

Historical Range and Abundance in California

Grinnell and Miller (1944) described the greater sage-grouse as a resident in northeastern, Great basin portions of California. Formerly abundant, but as a result of intensive sheep grazing and the penetration of the country by many roads they are greatly reduced in numbers and localized in occurrence (Grinnell and Miller 1944).

Recent Range and Abundance in California

Greater sage-grouse are found in the Great Basin region of northeastern California and east of the Sierra Nevada in Mono and northern Inyo counties. Greater sage-grouse are sagebrush obligates and are hence limited in range to semi-arid sagebrush habitat. They are known to inhabit the counties of Alpine, Lassen, Modoc, Mono, Inyo, and Sierra (Hall 1995).

Greater sage-grouse populations are closely allied with sagebrush (*Artemisia* spp.) habitats (Patterson 1952, Braun et al. 1977, Braun 1987). The dependence of sage grouse on sagebrush for winter habitat has been documented in numerous manuscripts (Eng and Schladweiler 1972, Beck 1975, Beck 1977, Robertson 1991). Also, the relationship between sagebrush habitats and sage grouse nest success has been well described (Klebenow 1969, Wallestad and Pyrah 1974, Wakkinen 1990, Connelly et al. 1991, Gregg et al. 1994). However, despite the well known importance of this habitat to sage grouse and other sagebrush obligates (Braun et al. 1976), the quality and quantity of sagebrush habitats has declined for at least the last 50 years (Braun et al. 1976, Braun 1987, Swenson et al. 1987, Connelly and Braun 1997).

In California, greater sage-grouse populations are estimated at between 4,000 and 8,000 birds in California using recent lek count data and population estimation methods described in Hall (1995). The Department has designated the sage grouse a Species of Special Concern because of potential threats to habitat. The U.S. Fish and Wildlife Service is currently reviewing a listing petition regarding the potentially distinct population segment of greater sage-grouse that occupy Mono County, California, and Lyon County, Nevada. Research (Quinn in press) indicates that this population segment is significantly different genetically than greater sage-grouse populations that occur in the remainder of their range. Initial DNA samples were taken from Mono County, California and Lyon County, Nevada, however, the population segment is presumed to extend into Inyo County, California, and in Douglas and Mineral counties, Nevada.

The original, historic range of greater sage-grouse in California was estimated to be 26,011 km^2 (6,427,239 acres) and the current range area is estimated to be 11,064 km^2 (2,733,895 acres), which is a 58% reduction in overall area. The two main areas of historic and current abundance are the Modoc-Lassen counties area in northeastern California and the Mono-Inyo counties area in the Great Basin portion of central California. The California Department of Fish and Game in cooperation with multiple wildlife and land management agencies have developed reliable Geographic Information System (GIS) data for active and historic lek locations and are in the process of developing data layers illustrating migration patterns, seasonal range, and potential habitat suitability. These data layers will provide a solid planning foundation for the current conservation planning activities ongoing between state and federal agencies, conservation groups, and local land use constituents.

Ecological Requirements

Leks, or breeding display sites, typically occur in open areas surrounded by sagebrush (Patterson 1952:92, Gill 1965); these sites include, but are not limited to, landing strips, old lake beds, low sagebrush flats and ridge tops, roads, cropland, and burned areas (Connelly et al. 1981, Gates 1985). Sage grouse males appear to form leks opportunistically at sites within potential nesting habitat.

Habitats used by pre-laying hens are also part of the breeding habitat. These areas provide hens with forbs high in calcium, phosphorus, and protein and the condition of these areas may greatly affect subsequent reproductive success (Barnett and Crawford 1994, J. A. Crawford, pers. commun.).

Most sage grouse nests occur under sagebrush (Patterson 1952:114, Gill 1965, Gray 1967, Wallestad and Pyrah 1974), but sage grouse will nest under other plant species (Connelly et al. 1991, Gregg 1991). However, sage grouse nesting under sagebrush experience higher nest success (53%) than those nesting under other plant species (22%) (Connelly et al. 1991). The height of sagebrush most commonly used by nesting grouse ranges from 36 to 79 cm (Patterson 1952:114,

Gray 1967, Klebenow 1969, Wallestad and Pyrah 1974, Wakkinen 1990, Fischer 1994, Gregg et al. 1994) and nests tend to be under the tallest sagebrush within a stand (Wakkinen 1990).

Sage grouse selected low sagebrush (*Artemisia arbuscula)*, big sagebrush (*A. tridentate*), and mixed shrub cover types (*Artemisia* spp., Chrysothamnus *nauseosus, Tetradymia glabrata,* or *Purshia tridentata*) for nesting during a study in Lassen County, California (Popham 2000). Nest success averaged 40.2% over a three year period between 1998-2000 (Popham 2000). Sixty seven percent of nest sites were found in big sagebrush cover type, 29% in mixed shrub, and 4% were found in low sagebrush cover types (Popham 2000). Low sagebrush cover types were used less than expected, while big sagebrush and mixed shrub cover types were used for nesting in proportion to their availability (Popham 2000). Other interesting comparisons made by Popham (2000) included; successful sage grouse nests were farther from the nearest lek than unsuccessful nests, rock cover was greater at successful nests than a unsuccessful nests, total shrub height was greater at successful nests, and visual obstruction was greater at successful nests.

Gregg (1991) indicated that sage grouse nest success varied by cover type. The highest nest success occurred in a mountain big sagebrush (*A. t. vaseyana*) cover type where sagebrush shrubs 40-80 cm in height had greater canopy cover at the site of successful nests ($\underline{0}$ = 42%) than at unsuccessful nests ($\underline{0}$ = 30%) (Gregg 1991).

Some studies have indicated that grass height is also an important component of sage grouse nest sites. Grass associated with nest sites and with the stand of vegetation containing the nest was taller than grass at random sites (Wakkinen 1990, Gregg 1991). Grass height at nests under non-sagebrush plants ($\underline{0}$ = 23 cm) was greater ($\underline{P} < 0.01$) than that associated with nests under sagebrush ($\underline{0}$ = 19 cm), further suggesting that grass height is an important habitat component for nesting sage grouse (Connelly et al. 1991). Furthermore, in Oregon, grass cover was greater at successful nests ($\underline{0}$ = 32%) than at unsuccessful nests ($\underline{0}$ = 9%) (Gregg 1991). Moreover, grass >18 cm occurring in

stands of sagebrush 40 - 80 cm tall resulted in lower nest predation rates than in stands with lower grass heights (Gregg et al. 1994, Delong et al. 1995). However, Popham (2000) found no differences in perennial grass cover or height between successful and unsuccessful nests potentially due to the high level of grazing in the study area. Popham (2000) did find that over-all visual obstruction was greater at successful nesting sites.

Early brood rearing areas occur in upland sagebrush habitats relatively close to nest sites but movements of individual broods may be highly variable (Connelly 1982, Gates 1983). These habitats may be relatively open (about 14% canopy cover) stands of sagebrush (Martin 1970, Wallestad 1971) with $\geq$15% canopy cover of grasses and forbs (Sveum et al. 1998). In Oregon, diets of sage grouse chicks included 34 genera of forbs and 41 families of invertebrates (Drut et al. 1994). Insects, especially ants (Hymenoptera) and beetles (Coleoptera), are an important component of early brood rearing habitat (Drut et al. 1994, Fischer et al. 1996*a*).

As sagebrush habitats desiccate, grouse usually move to more mesic sites during June and July (Gill 1965, Klebenow 1969, Savage 1969, Gates 1983, Connelly and Markham 1983, Connelly et al. 1988). These movements are correlated with vegetal moisture (Fischer et al. 1996b). Sage grouse broods occupy a variety of habitats during the summer including sagebrush (Martin 1970), wet meadows (Savage 1969), farmland, and other irrigated areas adjacent to sagebrush habitats (Connelly and Markham 1983, Gates 1983, Connelly et al. 1988).

Sage grouse use a variety of habitats during fall. Patterson (1952:187) reported that grouse move from summer to winter range in October but during mild weather in late fall some birds may still use summer range. Similarly, Connelly and Markham (1983) indicated that most sage grouse had abandoned summering areas by the first week of October. Fall movements to winter range are slow and meandering and occur from late August to December (Connelly et al. 1988). Wallestad (1975) documented a shift in feeding habits from September when grouse were consuming large amounts of forbs to December when birds were feeding only on sagebrush.

During winter, sage grouse feed almost exclusively on sagebrush (Patterson 1952, Wallestad et al. 1975). The distribution of sage grouse feeding activity can be influenced by topographic variation in snow depth and sagebrush exposure above snow (Hupp and Braun 1989). Remington and Braun (1985) indicated that sage grouse preferred to feed on Wyoming big sagebrush compared with mountain big sagebrush, apparently because of the higher protein content of Wyoming big sagebrush. Sage grouse also fed at sites where sagebrush contained higher protein than found at random sites and, regardless of subspecies of sagebrush, grouse fed on plants that contained the most protein (Remington and Braun 1985).

Threats

Type conversions of sagebrush habitat to reduce sagebrush cover in order to increase grass production for livestock grazing can potentially eliminate sage grouse use of an area. Herbicide treatments and prescribed burns were common methods in the past. Cheatgrass (*Bromus tectrorum*) will often occupy sites following disturbance, especially following burning (Valentine 1989). Repeated burning, or burning in late summer, favors cheatgrass invasion and may be a major cause of the expansion of this species (Valentine 1989). The ultimate result may be a loss of the sage grouse population because of permanent loss of sagebrush with rangeland dominated by an annual exotic grass.

Fire may improve sage grouse brood rearing habitat (Klebenow 1972, Gates 1983, Sime 1991) but, until recently, experimental evidence was not available to support or refute these contentions (Braun 1987). Pyle and Crawford (1996) suggested that fire may enhance brood rearing habitat in montane settings but cautioned that its usefulness requires further investigation. A 9-year study of the effects of fire on sage grouse failed to provide evidence that prescribed fire conducted during late summer in a Wyoming big sagebrush habitat improved brood rearing habitat for sage grouse (Connelly et al. 1994, Fischer et al. 1996*a*). Prescribed burning did not increase the amount of forbs in burned areas compared to unburned areas (Fischer et al. 1996*a*, Nelle 1998) and resulted

in decreased insect populations in the treated area compared to the unburned area. Thus, fire may negatively affect sage grouse brood rearing habitat rather than improve it in Wyoming big sagebrush habitats (Connelly and Braun 1997) but its effect on grouse habitats in mountain big sagebrush communities requires further investigation (Pyle and Crawford 1996, Nelle 1998).

Sage grouse often use agricultural areas for brood rearing habitat (Patterson 1952, Wallestad 1975, Gates 1983, Connelly et al. 1988, Blus et al. 1989). Grouse use of these areas may result in mortality because of exposure to insecticides. Blus et al. (1989) reported die-offs of sage grouse that were exposed to methamidiphos used in potato fields and dimethoate used in alfalfa fields. Dimethoate is commonly used for alfalfa and 20 of 31 radio-marked grouse (65%) died following direct exposure to this insecticide (Blus et al. 1989).

The effects of mining, oil, and gas developments on sage grouse populations are largely unknown (Braun 1998). These activities negatively impact grouse habitat and populations over the short term (Braun 1998) but research suggests some recovery of populations following initial development and subsequent reclamation of the affected sites (Eng et al. 1979, Tate et al. 1979, Braun 1986). In Colorado, sage grouse were displaced by oil development and coal mining activities but numbers returned to pre-disturbance levels once the activities ceased (Braun 1987, Remington and Braun 1991). Sage grouse may repopulate an area following energy developments but there is little evidence suggesting grouse populations will attain levels that occurred prior to development (Braun 1998). Thus, both short-term and long-term habitat loss is associated with energy development and mining (Braun 1998).

Domestic livestock have grazed over most areas used by sage grouse and this use is generally repetitive with annual or biennial grazing periods of varying timing and length (Braun 1998). Grazing patterns and use of habitats are often dependent on weather conditions (Valentine 1990:310). Historic and scientific evidence indicates that livestock grazing did not increase the distribution of sagebrush (Peterson 1995) but it markedly affected the understory over relatively

large areas and may have altered sagebrush density in localized areas (Vale 1975, Tisdale and Hironaka 1981). Moreover, grazing by wild ungulates may reduce sagebrush cover (McArthur et al. 1988, Peterson 1995) and livestock grazing may result in high trampling mortality of sagebrush seedlings (Owens and Norton 1992). There is little direct experimental evidence linking grazing practices to sage grouse population levels (Braun 1987, Connelly and Braun 1997). However, grass height and cover affect sage grouse nest site selection and success (Wakkinen 1990, Gregg 1991, Gregg et al. 1994, Delong et al. 1995, Sveum et al. 1998). Thus, indirect evidence suggests that excessive grazing by livestock or wild herbivores during the breeding season may have negative impacts on sage grouse populations (Braun 1987, Dobkin 1995). The development of roads, powerlines, fences, reservoirs, ranches, farms, land fills, and housing developments have resulted in sage grouse habitat loss and fragmentation (Braun 1998). Structures such as powerlines and fences pose a hazard to sage grouse because they provide additional perch sites for raptors and sage grouse may be injured or killed when they fly into these structures (J. W. Connelly, unpubl. data). The construction of ranches, farms, and housing developments has also resulted in the addition of non-native predators to sage grouse habitats including dogs and cats. Native predator populations may also be elevated due to human caused alterations such as an increase in available domestic prey and an increase in available garbage.

Prolonged drought during the 1930s and mid-1980s to early 1990s coincided with declining sage grouse populations throughout the species' range (Patterson 1952, Fischer 1994, Hanf et al. 1994). Drought may affect sage grouse populations by reducing herbaceous cover at nests and the quantity and quality of food available for hens and chicks during spring (Hanf et al. 1994, Fischer et al. 1996a). Spring weather may influence sage grouse production. Relatively wet springs may result in increased production (Wallestad 1995, Autenrieth 1981). However, heavy rainfall during egg-laying or unseasonably cold temperatures with precipitation during hatching may decrease production (Wallestad 1975; J. W. Connelly, pers. obs.). There is no evidence that severe winter

weather affects sage grouse populations unless sagebrush cover has been eliminated (Wallestad 1975, Beck 1977, Robertson 1991).

Management and Research Recommendations

- Continue to participate in the local sage grouse conservation planning process and develop local conservation plans.
- Continue to develop GIS data layers illustrating seasonal migration patterns, seasonal ranges, and habitat suitability models.
- Using standard radio telemetry techniques, evaluate habitat selection by hens during nesting brooding activities, as well as nest success, and brood success. This research is needed for Modoc, Mono, and Inyo counties.
- Complete the behavior/morphological evaluation of greater sage-grouse within the Mono/Inyo population segment to determine their relatedness to greater sage-grouse throughout the remainder of their range.
- Initiate research to evaluate if landfills cause significant increases in nest predation rates of greater sage-grouse.

Monitoring Needs

Currently, greater sage-grouse lek counts are annually conducted on every known active lek in California. Historic lek locations are visited periodically to evaluate habitat and determine if the site has been reoccupied by greater sage-grouse. Annual wing collections are conducted within specific hunt zones each year. Wings are analyzed to determine sex, age, and nesting initiation rates. Brood surveys are conducted in portions of their range to estimate production. Radio telemetry projects are currently being conducted on greater sage-grouse in several locations within California to determine migration patterns, seasonal range, and in some cases to estimate nest and brood success.

Monitoring of sagebrush habitat is being conducted by land management agencies to determine greater sage-grouse habitat suitability. These data, as well as additional random plots are needed to evaluate how the California greater sage-grouse range compares to the sage grouse management guidelines (Connelly et al., 1999).

Acknowledgments

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